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# Cost of Climate change Hazards on Livelihood Capitals of Farmers in Coastal Communities of Delta State of Nigeria

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***Abstract***— *Climate change comes with hazards that impose cost on livelihood capitals that are very important to agriculture in particular and the economy in general. This study was aimed at eliciting evidence of Climate change and it's associated hazards and estimating monetary cost of the hazards on livelihood capitals with a view to making recommendations that will minimise the cost on livelihood capitals of farmers in coastal communities of Delta State of Nigeria. The study area which is found within the Niger Delta region of Nigeria that is ecologically characterised by rivers, tributries, wet lands, mangrove swamps and a rich collection of aquatic and terrestrial floral and fauna, is also the concentration of petroleum exploration and production in Nigeria. Random sampling procedure was used to select 240 respondents from 8 communities that were purposely selected for the study.Cost was estimated by Willingness to Pay (WTP) and it's determinants analysed with regression model. Findings revealed that the people perceive climate change in terms of unusual changes in frequency and intensity of climate variables and the hazards associated with these changes are coastal erosion, flood, extreme heat and "wind and rain storm". Climate change through the hazards was estimated to cost the average respondent 49,440 Nigerian naira or 123.60 US dollars (in livelihood capitals all of which are important to agriculture and the economy. Coastal erosion, flood, wind/rain storm and extreme heat were positively related to cost while literacy level, adaptation and number of income generating activities were negatively related to cost. Capacity building for improving existing adaptation strategies, literacy improvement, direct intervention projects and insurance were recommended as measures for minimising the cost of climate change on livelihood capitals of farmers in Coastal communities of Delta State of Nigeria.*

***Keywords***— ***Cost, Climate change, Livelihood capitals, Farmers, Coastal Communities.***

## I. INTRODUCTION

The Intergovernmental Panel on Climate Change (ICPC) define Climate Change as any significant change in climate over time whether due to natural climate variability or as a result of human activity (Abazu and Abimbola, 2019). The main cause of climate change is global warming which results from accumulation of greenhouse gases like carbon dioxide, nitrous oxide, methane and chlorofluorocarbon. Carbon dioxide remain the most important influencer of climate change and it's concentration has been increasing since 1750 through 2019 (IPCC, 2021).

Climate Change is associated with hazards like extreme heat, flood, erosion, extreme rain and wind storm. Coastal communities are particularly more vulnerable to these hazards (Sinay and Bill, 2020). Many coastal communities especially in developing countries have limited or no human built protection against the hazards.

Kramer et al, (2017), established a strong relationship between coastal habitats and livelihoods of it's inhabitants. In this way, vulnerability of coastal communities to climate change, impose cost on the livelihoods of the people. This will be better understood by studying the cost imposed by climate change through associated hazards on

livelihood capitals of farmers in coastal communities of Delta State of Nigeria. The study will also contribute to the information needed by policy makers to protect natural and human capitals against climate change. The United State's Geological Survey (2008) emphasised that such information is needed by policy makers in coastal communities.

The cost of climate change is projected to be up to 3.6 percent of GDP by 2100 according to the Natural Resources Defense Council (NRDC) (2008). Uyigue and Agho (2007) describe the coastal communities of Delta State of Nigeria as predominantly farming and fishing communities. Therefore, this study which could contribute to policies that will reduce cost of climate change on livelihood capitals in the study area will also reduce the cost to farming households, increase income of farmers and improve welfare of farmers. The study is aimed at satisfy the following objectives.

1. Elicit evidence of Climate change and it's associated hazards from farmers in the coastal communities of Delta State of Nigeria.
2. Estimate the cost of the hazards on livelihood capitals of farmers in study area.
3. Analyse the determinants of cost of the hazards on livelihood capitals of farmers in the study area.
4. Generate recommendations that will help to minimise cost of climate change on livelihood capitals in the coastal communities of Delta State of Nigeria and similar ecosystems elsewhere.

**Hypothesis:**

Climate change does not impose cost on livelihood capitals of farmers in coastal communities of Delta State of Nigeria.

## II. METHODOLOGY

### The Study Area

The study was conducted in Delta State of Nigeria with coordinates of Latitude $5.30^0$N and Longitude $6.00^0$East. The state has a land mass of 17698 kilometers square.

Delta State is ecologically divided into three agricultural zones: Delta North, Delta Central and Delta South. The topography of Delta North agricultural zone range from low lying planes to undulating hills of between 243 and 275 meters above sea level with only a few depression of river valleys and flood plains. The Delta Central and Delta South agricultural zones are predominantly coastal consisting of fresh water and mangrove swamps, alluvial plains and beach ridges. Therefore, the study was concentrated on the south and Central agricultural zones.

The study area share similar ecology with other coastal communities in the Niger Delta region of Nigeria which it also belongs in ecological and political grouping in Nigeria. The Niger Delta region is located in the Atlantic coast of southern Nigeria where the river Niger divide into many tributaries. Hence the name Delta.

### Scope of the study

The study was limited to coastal communities in Delta State of Nigeria. The cost that was estimated include cost on all livelihood capitals in the study area. Only primary data generated in the field were used for the study.

### Sampling procedure

Purposive sampling procedure was used to select 8 coastal communities in the study area after which 30 respondents were selected from each to give a sample size of 240. Communities selected for the study are Ekpan in Uvwie local Local Government Area (LGA), Egbo-Ideh in Ughelli South LGA, Abaro in Patani LGA, Aladja in Udu LGA, Oteghele in Warri south LGA, Ayakoromo in Burutu LGA and Bomadi in Bomadi LGA.

### Data Collection

Questionnaire were used to collect data on the people's socio economic characteristics and perceived changes in climate and associated hazards in the study area. Cost on livelihood capitals were also collected. Data were collected from only persons of 40 years and above in order to obtain valid responses regarding climate change and associated hazards in the study area.

### Data analysis

Data on observed changes in climate and associated hazards were analysed by the use of descriptive statistics like tables, frequency distribution and percentages. Cost of the hazards on livelihood capitals was obtained by the use of Willingness to pay methodology of social cost valuation. This was used to obtain the cost on each livelihood capital and aggregated to obtain the total cost on livelihood capitals. Nigerian naira and US dollar are the currencies adopted for presentation and interpretation of results.

Determinants of cost of climate change hazards were analysed by the use of multiple regression analysis. The model was explicitly specified as

$$Y = a+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6+b_7X_7+b_8X_8+b_9X_9+c$$ ; where

Y = estimated cost in dollars of climate change hazards on livelihood capitals

A= intercept

$X_1$= age of respondents measured in years

$X_2$= gender (dummy variable) 1 for male and 0 for female

$X_3$= level of education: number of years in formal education

$X_4$= livelihood options: number of income generation activities

$IX_5$= coastal erosion: 0 for not severe, 1 for extreme

$X_6$= flood: 0 for not severe, 1 for extreme

$X_7$= wind/rain storm: 0 for not severe, 1 for extreme

$X_8$= unusual extreme heat. 0 for not observed, 1for observed

$X_9$= adaptation to climate change hazards: money spent on adaptation in dollars

$b_1$, $b_2$…….$b_9$ = coefficients of the independent variables ($X_1$,$X_2$……..$X_9$) respectively.

E = error term which account for variables not included in the model.

The coefficients of the explanatory variables ($b_1$, $b_2$…….$b_9$) as specified in the model, indicates the net effect of a unit change in each of the explanatory variables ($X_1$, $X_2$……..$X_9$) on the cost of climate change on livelihood capitals. The coefficient of determination R square and F statistic of the regression analysis were used as measures of goodness of fit. R square indicates the degree of explanation for the cost of climate change on livelihood capitals in the coastal communities of Delta State of Nigeria that is collectively provided by the explanatory variables. F statistic measures the significance of the combined effect of all the variables. Therefore, the linear model of the regression analysis was adopted as lead equation for interpretation of result ahead of the semi log and double log functional forms that were also fitted because it's R square F statistic were superior.

**Decision rule for Hypothesis**

A positive value for any of the dependent variables representing climate change related hazards in the model will lead to a decision of "do not accept" for the hypothesis.

**Apriori expectation**

It is expected that hazards associated with climate change will be positively related to the cost of the hazards on livelihood capitals in the coastal communities of Delta State of Nigeria. This is based on explanation of the human ecology theory that ecosystem services provided by ecosystems functions may result to negative effects in the ecosystem if their utilisation alter natural cycles and balance in the ecosystem (Montayo and Raffaelli, 2010).

## III. RESULTS AND DISCUSSION

**Livelihoods and Other Socio Economic Characteristics**

The age of respondents is between 41 and 78 years and the mean age is 56 years. The survey was evenly distributed along gender lines. Most of the respondents are married (95 percent) and majority of households have 4-7 persons. About half of the respondent had primary education. More than half of the remaining 50 percent do not have formal education while only a fewer number had post primary education. The mean annual income is about 600 dollars.

Many people in the coastal communities of Delta State of Nigeria are engaged in multiple income generating activities or livelihood options. It is only 35 percent of the people that rely on only one source of income while 42.5 percent and 22.5 percent engage in 2 and three income generating activities respectively. The mean number of income generating activities in the study area is 2.

**Climate Change and Associated Hazards**

Therewas a unanimous agreement by respondents that climate change is experienced in the coastal communities of Delta State of Nigeria. This is based on their observation of changes in pattern of rain fall and intensity of heat over the years. The change in pattern of rain fall was through intensity, frequency of events and duration of the season of rain (Table 1). This is in agreement with the findings of Li (2011) that climate change induced by pollution has resulted to increase in rain in coastal regions of the world.

The strongest evidence of climate change in the study area is in intensity of heat. All the respondents observed a drastic increase in intensity of heat in the coastal communities of Delta State of Nigeria. This is in line with data from Nigerian Metereological Agency (NIMET) as in Okoh et Al (2011).

It was also observed by all the respondents that there is a decrease in the intensity of harmattan. 92 percent observed delayed onset while 91 percent observed decrease in duration (Table 1). The findings agree with Abbey (2011) which linked delay in onset of harmattan in Ghana to climate change. The findings however, disagree with Abbey (2011) in the area of intensity. Abbey (2011) reported increase in intensity while this study found decrease intensity as shown in Table 1. The peculiarity of the coastal ecosystem and location could be responsible for this because according to Fernandez-Bilbao (2011), climate change could be affected to some extent by geographical distribution although it is a global phenomenon.

It is shown in Table 2 that erosion, flood and "rain and wind storm" are hazards associated with climate change in

the Coastal communities of Delta State of Nigeria. These hazards assumed extreme proportions in line with extreme changes in climate as observed by the respondents. This confirms the report of Li (2011) that climate change has increased the intensity of severe storms in coastal regions of the world. It is also in line with Kumar (2011) that flood and erosion are important climate change related hazards in coastal communities.

**Cost of Climate Change Hazards on Livelihood Capitals**

The cost imposed by climate change through associated hazards on livelihood capitals in coastal communities of Delta State of Nigeria is very high as it affects all livelihood capitals. The total cost to the average respondent is 49440 naira or 123.60 US dollars. The highest cost was recorded in natural capital where the mean cost to each responded was 21,752 naira or 61.88 dollars (Table 2). The cost on other livelihood capitals as presented in Table 2 are physical capital: 9,152 naira (22.88 dollars), financial capital: 8,460 naira (21.15 dollars), social capital: 2,976 naira (7.44 dollars) and human capital: 5,056 naira (12.64 dollars). The cost to agriculture is overwhelming as all components of the affected livelihood capitals as presented in Table 2 are relevant to sustainable agriculture and welfare of farmers and farming households.

Result of the regression model presented in Table 3 indicates a positive relationship between all the variables representing climate change hazards and cost on livelihood capitals in the study area. Flood, coastal erosion and wind/rain storm are significant. The implication is that as the hazards become more extreme, cost on livelihood capitals in the coastal communities of Delta State of Nigeria also increase. Therefore, we do not accept the null hypothesis. Adaptation, formal education and number of income generating activities are found to be negatively related to cost.

## IV. CONCLUSION AND RECOMMENDATIONS

Cost of climate change through hazards like flood, coastal erosion, wind and rain storm and extreme heat on livelihood capitals of farmers in coastal communities of Delta State of Nigeria is very high as all livelihood capitals including agricultural resources and infrastructure are affected. Therefore, the following recommendations should be considered in order to minimise the cost.

1. Capacity building to improve on existing adaptation strategies.
2. Early warning of predictable extreme events related to climate change.
3. Investment in education to increase understanding of climate change information.
4. Direct intervention projects by government and development agencies.
5. Investing in additional income generating activities.
6. Insuring livelihood assetsof farmers in coastal communities against climate change related hazards.

*Table 1: Evidence of Climate Change and Associated Hazards in the coastal communities of Delta State*

| | | |
|---|---|---|
| Rain fall more intense: | Agree (212 or 88 percent) | disagree (28 or 12 percent). |
| Rain fall more frequent. | Agree (179 or 70 percent) | disagree (38 or 16 percent) |
| Rain onset delayed: | Agree (150 or 60 percent) | disagree (90 or 40 percent) |
| Heat intensity is increasing | Agree (240 or 200 percent) | disagree (0 or 0percent) |
| Harmattan is less intense: | Agree (240 or 100 percent) | disagree (0 or 0 percent) |
| Harmattan onset delayed: | Agree (231 or 96 percent) | disagree (9 or 4 percent |
| Harmattan duration reduced: | Agree (218 91 percent) | disagree (22 or 9 percent) |

Source: researcher (field survey)

*Table 2: Cost of Climate Change on Livelihood Capitals in Naira and US dollars in study area*

| Livelihood Capital | cost to male | | cost to female | | mean cost | |
|---|---|---|---|---|---|---|
| | Naira | Dollars | Naira | Dollars | Naira | Dollars |
| Natural Capital: Loss of farm land | 7252 | 18.13 | 14000 | 35.00 | 10600 | 2 6.56 |
| Damage to cultivated crops. | 1552 | 3.88 | 1524 | 3.81 | 1536 | 3.84 |
| Less productive fishing ground | 12700 | 31.75 | 7876 | 19.69 | 10288 | 25.72 |
| Polluted water | 824 | 2.06 | 1000 | 2.50 | 916 | 2.29 |
| Damage to livestock | 1600 | 4.00 | 1176 | 2.94 | 1388 | 3.47 |
| Sub total | 22824 | 57.06 | 25576 | 63.94 | 24752 | 61.88 |
| Physical Capital: Damage to farming equipment | 1600 | 4.00 | 3524 | 8.81 | 2564 | 6.41 |
| Damage to fishing equipment | 4024 | 10.06 | 2076 | 5.19 | 3052 | 7.63 |
| Damage to roads and bridges | 1224 | 2.81 | 952 | 2.38 | 1080 | 2.59 |
| Damage to school infrastructure | 724 | 1.81 | 800 | 2.00 | 776 | 1.92 |
| Damage to health infrastructure | 675 | 1.69 | 852 | 2.13 | 764 | 1.91 |
| Damage to market infrastructure | 776 | 1.94 | 1176 | 2.94 | 1388 | 3.47 |
| Sub total | 8924 | 22.31 | 9380 | 23.45 | 9152 | 22.88 |
| Financial Capital: Reduced income from farming | 2052 | 5.13 | 4532 | 11.33 | 3292 | 8.23 |
| Reduced income from fishing | 3176 | 7.94 | 1800 | 4.50 | 2488 | 6.22 |
| Reduced sources of income | 1028 | 2.59 | 736 | 1.84 | 888 | 2.22 |
| Reduced savings | 852 | 2.13 | 672 | 1.68 | 764 | 1.91 |
| Reduced credit facilities | 952 | 2.38 | 720 | 1.80 | 836 | 2.09 |
| Sub total | 8076 | 20.19 | 8460 | 21.15 | 8268 | 20.67 |
| Social Capital: Separated relatives | 558 | 1.47 | 912 | 2.28 | 752 | 1.88 |
| Weaker co-operative societies | 1024 | 2.56 | 700 | 1.75 | 864 | 2.16 |
| Less active social groups | 528 | 1.32 | 952 | 2.38 | 740 | 1.85 |
| Increased communication gap | 512 | 1.28 | 736 | 1.84 | 624 | 1.56 |
| Sub total | 2632 | 6.63 | 3300 | 8.25 | 2976 | 7.44 |
| Human Capital: Increased health risk | 900 | 2.25 | 1024 | 2.56 | 964 | 2.41 |
| Increased migration | 476 | 1.19 | 952 | 2.38 | 716 | 1.79 |
| Higher death rate | 2252 | 5.63 | 2652 | 6.63 | 2452 | 6.13 |
| Reduced skilled labour | 852 | 2.13 | 1000 | 2.50 | 926 | 2.32 |
| Sub total | 44801 | 1.20 | 5628 | 14.07 | 5056 | 12.64 |
| Total | 46952 | 117.38 | 52316 | 130.79 | 49440 | 123.60 |

Source: researcher (field survey)

*Table 3: determinants of cost of climate change on livelihood capitals in the study area*

| Variable | Coefficient | Std Error | T | p-value |
|---|---|---|---|---|
| C1008.34 | 951.80 | 1.059 | 0.2444 | |
| Age | 197.85 | 82.10 | 2.410 | 0.0347* |
| Gender | 38.18 | 33.36 | 1.140 | 0.2021 |

| | | | | |
|---|---|---|---|---|
| Education | -200.86 | 187.49 | 1.060 | 0.2444 |
| Livelihood options | -797.13 | 265.71 | 3.000 | 0.0100** |
| Erosion | 946.00 | 287.15 | 2.490 | 0.0291* |
| Flood | 221.19 | 570.90 | 3.540 | 0.0070 |
| Extreme heat | 211.48 | 188.48 | 1.220 | 0.2239 |
| Wind/rain storm | 586.60 | 241.40 | 2.430 | 0.0302* |
| Adaptation | -14.77 | 5.86 | 2.520 | 0.0210* |

Source: researcher (regression analysis)

*= significant at 5 percent, **= significant at 1 percent

R-square = 78.22

F statistic. = 101.11 (p-value = 0.00102)

Durbin Watson = 1.69

## REFERENCES


[1] Abazu C.I AND T.A Abimbola (2019). *Fostering Urban Environment to Climate Change in Nigeria*. African Journal of Environmental Research. Vol 3, No. 1, 2019: pp 41-53.

[2] Abbey E.N (2011). *Climate Change Ushers in Severe Harmattan*. Western Publications Limited. Retrieved from http://www.businessguide.com/?p3076.

[3] Fernandez-Bilbao A. (2011). *Impacts of Climate Change on Disadvantaged UK Costal Communities*. Retrieved from http://wwwirf.org.uk/Publications/impacts-climate-change-disadvantaged-uk-coastal-communities.

[4] ICPC (2021). *Summary for Policy Makers in: Climate Change 2021: The Physical Science Basis. Contribution of Working Group 1 to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. In press.

[5] Kramer B, Hellin J, Hansen J, Rose A, Braun M. (2019). *Building Resilience through Climate Risk Insurance: insights from Agricultural research for advancement*. CCAFS Working Paper No. 287 Wageningen, the Netherlands: CGIAR Research Program on Climate, Agriculture and Food Security (CCAFS).

[6] Kumar, P.P. (2011). *Climate Change and Livelihood Vulnerability – a micro level Assessment* In: Proceeding of 6th International Conference on Tropical Island Ecosystem. March.Tie.com publishers.

[7] Li, Z. (2011). as in: The Guardian (2011). *How Rising Air Pollution Worsen Drought, Flood by Study*. Lagos: Guardian Newspapers Limited: pp 33.

[8] Montayo J. and D. Raffaeli (2010). *The Effects of Climate Change on Biotic Interactions and Ecosystem Services.* In: Phylosophical Transactions of the Royal Society of London, Series B. Biological Sciences. Vol 365 No.1549 pp 2012-2011.

[9] NRDC (Natural Resources Defense Council). (2008). *The Cost of Climate Change: What We Will Pay If Global warming Continue Unchecked*. Retrieved from http://www.nr.dc.org/global warming/cost/content/asp

[10] Okoh, R.N, P.N Okoh, M, Ijeoma, A.I Ajibefu, K.I Idehen, P.C Ajieh, A.A. Nwabueze, J.O. Ovarhe, J. Emegho and E.U. Osakwuni (2011). *Assessment Change and Adaptive Capacity in the Niger Delta Region, Nigeria*. A research Report Submitted to Building Nigeria's Response to Climate Change (BNRCC). Asaba: pp 27-94.

[11] Sinay, L and R.W Bill (2020). *Climate Change Adaptation Options for Coastal Communities and Local Governments*. Retrieved from http//:www.researchgate.net/publication338466630_Climate_Change_Adaptation_Options_for_Coastal_Communities_and_Local_Governments.

[12] US Geological Surgery (2008). *Climate Change: Impact on Coastal Communities.* Retrieved from http://www.usgs.gov/solutions/climate changes:28March08.html.

[13] Uyigue, E and M. Agho (2007). *Coping with Climate and Environmental Degradation in the Niger Delta of Southern Nigeria*: Community Research and Development Centre (CREDC).